

Thermal Coal Drying and Beneficiation Systems



We Make Your Work Flow

Carrier[®]
Vibrating Equipment, Inc.

Special Requirements of Thermal Coal Drying Systems

Designing a thermal coal drying system is quite different than developing drying systems for most other materials. Considering the wide range of coal types and processing applications, system requirements and drying characteristics vary greatly. Design requirements are not only affected by the type of coal to be dried, but also the source of the coal and the specifics of each unique application.

Engineering systems to thermally dry disparate types of coal—efficiently, safely and economically—can only be learned through years of coal processing experience. **Carrier has this experience.** Carrier has designed drying systems for a wide range of coal types and applications including:

- Run-of-mine coal
- Coal fines from a prep plant
- Steam coal
- Washed and sized bituminous coal
- Filter cake
- Reclaimed waste coal
- Coking or metallurgical grade coal
- Subbituminous or lignite coal prepped for gasification or liquefaction processes

Carrier system engineers take into account each of these coal types and application processes that require special considerations and/or drying system features. For example, filter cake coals are very fine and typically hold a high volume of water. Therefore, a filter cake coal dryer must be able to handle high evaporative loads and high entertainment levels in the exhaust gases. Some coals, such as lignite, are subject to spontaneous combustion and explosions. A dryer for lignite should include explosion venting, a water deluge system and possibly an inert gas or a recirculated self-inerted process gas. Conversely, anthracite coal exhibits a high ignition temperature, rendering explosion vents or a deluge system unnecessary.

Carrier has developed a number of thermal coal drying systems for several types of coals and process applications. Some of these include:

- Anthracite coal for additives in the steel making industry
- Metallurgical grade bituminous coals used in making coke
- Bituminous coals used in direct steel making processes such as the “Corex” process
- Beneficiation of PRB coals
- Beneficiation of lignite coals
- Lignite coals prior to gasification or liquefaction

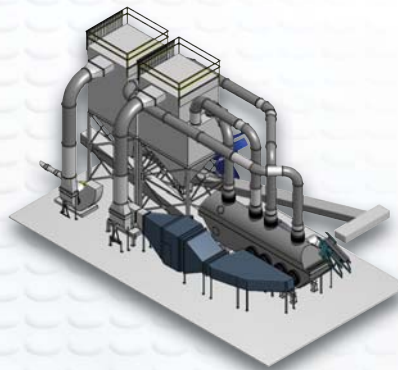
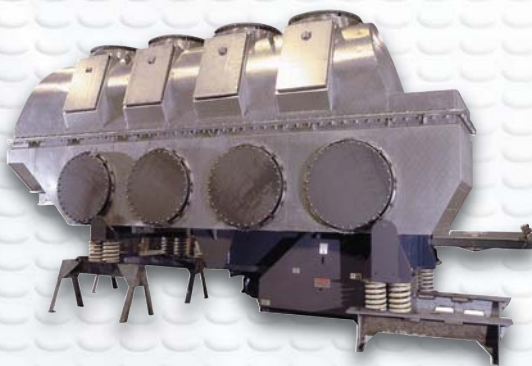
Dryers for the Demanding Requirements of Thermal Coal Drying

To meet the needs of all of the different grades of coal and the different applications, Carrier offers several types of dryers. These include:

- Vibrating fluid bed dryers
- Conventional flash or Tomesh flash dryers
- Conventional (non-vibrating) fluid bed dryers
- Conventional (non-vibrating) fluid bed dryers with in-bed heat exchangers

Vibrating Fluid Bed Dryers

Over the past 50 years, Carrier has built numerous **vibrating fluid bed dryers** for coal processing applications. Vibrating fluid bed thermal dryers are typically used for coals with a larger size fraction (such as run-of-mine coal). Vibration significantly assists in the fluidization of sticky and/or wet coals, and helps convey larger particles that may not fluidize well and tend to settle to the bottom of the bed. Carrier offers vibrating fluid bed units **up to 8’ wide x 50’ long** with capacities **up to 250 TPH in a single unit**, depending on the thermal load.



Thermal coal dryers and drying systems utilizing vibrating fluid bed units



Thermal coal dryers and drying systems utilizing vibrating fluid bed units

Conventional (Non-Vibrating) Fluid Bed Thermal Dryers

Conventional fluid beds are typically used for coals with a smaller size fraction, such as washed crushed coals or fines, and can also handle fairly coarse coal from 1/2" up to 1" with very high fluidization velocities. Lower rank coals (low rank subbituminous, PRB, or lignite coals) handle well in conventional fluid beds with larger size fractions because they tend to thermally break-down while being dried. Conventional fluid beds offer the advantage of being able to be built much larger than vibrating fluid beds. Carrier currently offers conventional fluid beds **up to 15' wide x 80' long** with drying capacities of up to **500 TPH in a single unit** depending on the thermal load. Even larger custom designed units are possible if the application requires it.



Thermal dryers and drying systems utilizing conventional fluid bed units

Conventional (Non-Vibrating) Fluid Bed Thermal Dryers with In-Bed Heat Exchangers

Conventional fluid bed thermal dryers with in-bed heat exchangers are used for increased thermal input, for higher evaporative loads, or where lower process gas temperatures are being used, particularly to take advantage of lower temperature waste water such as at a power plant. In-bed heat exchangers can also be used with steam as a heat medium. Alternatively, they can also be used with super heated high-pressure steam with a closed loop recirculated indirect heated, super heated atmospheric pressure steam as the process gas. This setup results in a very high efficiency inert thermal coal drying system for high volatile coals.

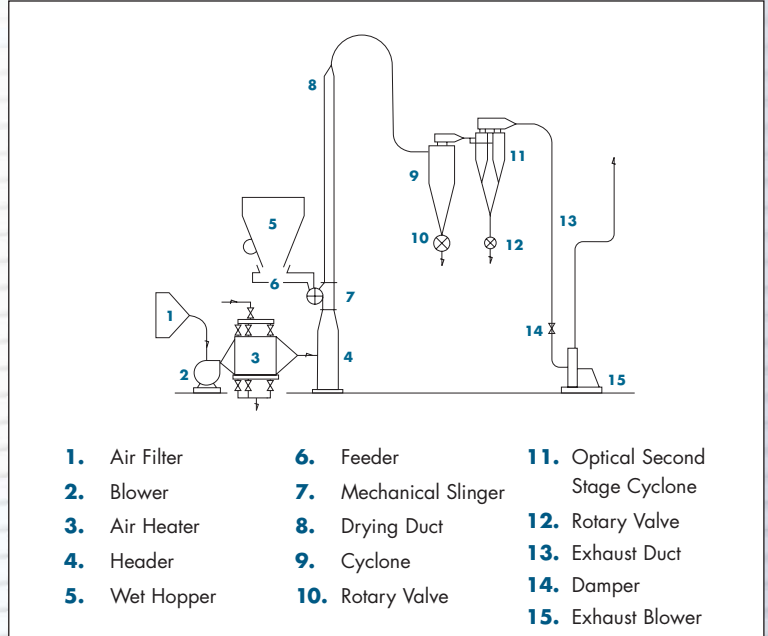


Conventional fluid bed unit with in-bed heat exchangers

Carrier's standard tube type in-bed heat exchanger

Conventional Flash or Tornesh Flash Thermal Dryers

Convention flash dryers, with their high capacity and ability to handle very fine particles, are excellent for thermal drying of fine coals such as filter cakes or crushed coals (particularly those with high moisture contents and high evaporative loads). Moisture can typically be reduced to the inherent moisture level of the coal. Recirculating the process gas greatly enhances the efficiency, and can be beneficial for drying lower rank coals by helping to render the process inert and preventing potential explosions.

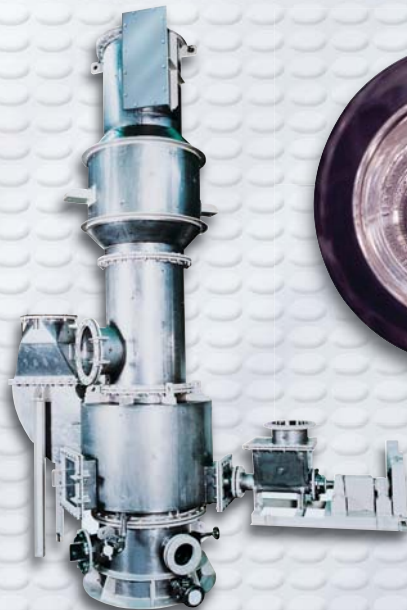


Conventional Flash Thermal Dryers

Tomesh flash dryers offer the advantage of longer retention time and higher drying efficiency for applications that require drying to lower moisture levels. Materials to be dried are fed into the feed chamber of the unit and begin to swirl in a cyclonic pattern like a tornado. As moisture is removed from the product, it becomes lighter and eventually is entrained in the swirling upward hot gas stream. This swirling motion creates a more torturous path for the process gas to travel, increasing the retention time in the drying chamber and heat transfer while lowering the moisture content.



Tomesh Flash Thermal Dryers



Internal Construction



Feed Chamber

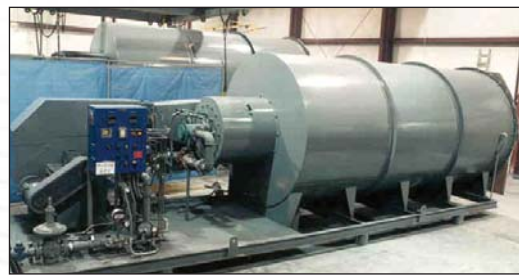
Typical System Arrangements for Thermal Coal Drying Systems

The system arrangement used for a specific application will depend on the type of coal being dried, the application requirements and the process requirements of the application. The schematic will vary, not only based on the type of thermal dryer used, but also the choice of system auxiliary components and how they are interconnected. Because Carrier's thermal coal drying systems are custom designed for the application, there are an infinite number of arrangements and component combinations that can be provided. Some of these arrangements include:

- **Systems that dry only.**
- **Systems that dry and cool.**
- **Systems that recirculate the cooling zone exhaust gas to the drying zone supply for improved efficiency.**
- **Systems with closed loop recirculated process gas streams that are heated with a direct-fired process gas heater.**
- **Systems with closed loop recirculated process gas streams that are heated with indirect heat.**
- **Systems with recirculated self-inerted process gas streams heated by direct-fired process gas heaters.**
- **Systems with recirculated indirect heated inert process gas streams, such as nitrogen, with in-bed heat exchangers.**

The direct-fired systems offered by Carrier can be fired by a number of fuels, including but not limited to:

- **Natural gas**
- **Propane**
- **Fuels oils**
- **Coal fines**
- **Stoker coal**
- **Blast furnace gas**
- **Coke oven gas**
- **Other "Low BTU" by-product gases**

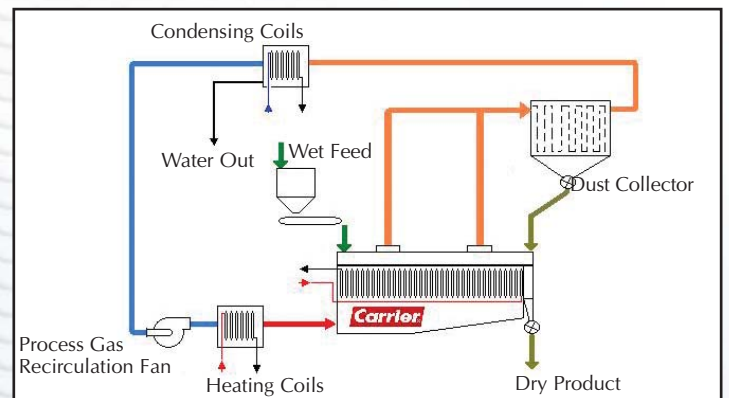
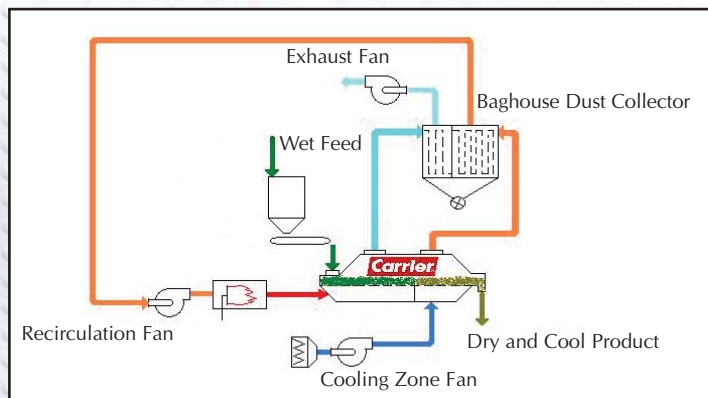
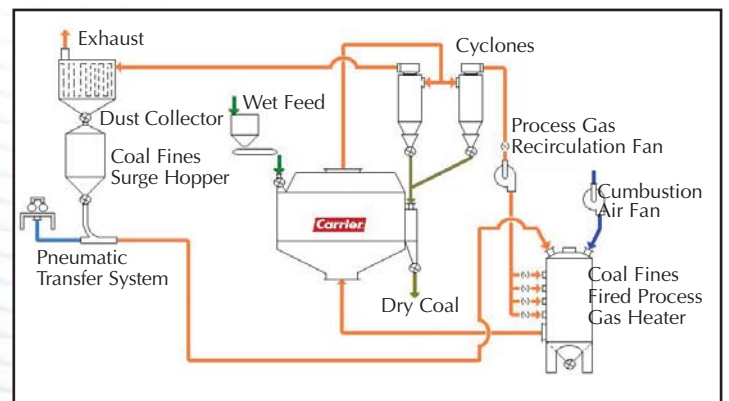
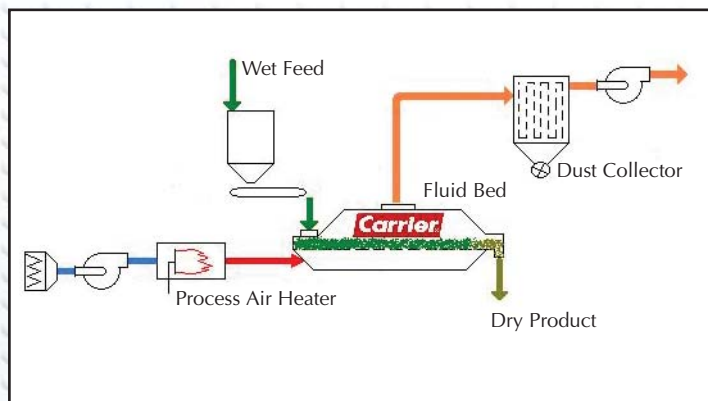


Gas Fired Heater



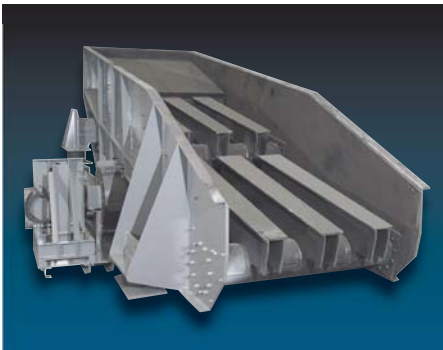
Coal Fines Fired Heater

The following process flow schematics represent a few of the system arrangements and combinations that Carrier has either provided or can provide for thermal coal drying applications:





Vibrating Feeder



Grizzly Feeder



Vibrating Screen



Storage Pile Discharger



Corporate Profile

Established in 1950, Carrier is internationally known for its pioneering work in the field of bulk material handling and processing. Carrier specializes in the manufacture of fluid bed processors, pneumatic dryers, vibrating conveyors, feeders, screeners, and spiral elevators.

Through the years, Carrier has developed processing equipment to meet the needs of a broad range of industries, including chemicals, synthetics, foundry, glass, food, explosives, wood, coal, metals, scrap, and recycling.

Carrier continues to bring new technology to the market, as well as new value to existing technology through its Research and Development Lab. The lab serves as a technology base in which to confidentially test the feasibility of new products and processes, simulating actual operating conditions.

With a technology profile of over 150 patents, each application is custom tailored. Computer assisted design and manufacturing procedures provide the background for the innovative engineering required to achieve unmatched production efficiencies.

With an extensive line of processing machines and vibrating equipment, we are your **ONE-STEP SOLUTION** to:

- Accumulate
- Agitate
- Blanch
- Blend
- Calcine
- Classify
- Cool
- Convey
- De-Oil
- Dewater
- Distribute
- Divide
- Dry
- Dry/Cool
- Elevate
- Feed
- Flatten
- Heat
- Meter
- Moisten
- Orient
- Proportion
- Quench
- Recycle
- Scalp
- Screen
- Separate
- Shakeout
- Singulate
- Solidify
- Sort
- Tumble
- Wash
- Withdraw

Representatives

Carrier is represented by more than 75 manufacturer's representative organizations throughout the U.S., Canada, Mexico, Korea, Peoples Republic of China, Taiwan, Chile, Argentina, Columbia, Brazil, Peru, Eastern Europe, and Western Europe. Licensees: India, Japan, Sweden, and Australia.

Contact our United States office for the nearest representative in your area.

Locations

United States: **Carrier Vibrating Equipment, Inc. and Vibranetics Division**
 P. O. Box 37070 • Louisville, Kentucky 40233-7070
 Phone: (502) 969-3171 • Fax: (502) 969-3172
 E-mail: cve@carriervibrating.com • Web site: www.carriervibrating.com

Canada: **Carrier Vibrating Equipment Canada**
 P. O. Box 759 • Aurora, Ontario L4G 4J9
 Phone: (905) 727-3185 • Fax: (905) 727-3187
 E-mail: cve@carriervibrating.ca

Europe: **Carrier Europe sca**
 Parc Industriel-Zone 1
 Rue de l'Industrie, 20 • B-1400 Nivelles, Belgium
 Phone: 32-67-883753 • Fax: 32-67-883759
 E-mail: ceur@carriereurope.be